Global Hydrology Resource Center

Data User Guide

TCSP European Centre for Medium-Range Weather Forecasts (ECMWF)

Introduction

The TCSP European Centre for Medium-Range Weather Forecasts (ECMWF) dataset consists of three-hour forecast/analysis data for the Tropical Cloud Systems and Processes (TCSP) field campaign, supplied by ECMWF. The TCSP field campaign was conducted from July 1 through July 27, 2005 out of the Juan Santamaria Airfield in San Jose, Costa Rica. TCSP collected data for research and documentation of cyclogenesis, the interaction of temperature, humidity, precipitation, wind, and air pressure that creates ideal birthing conditions for tropical storms, hurricanes, and related phenomena. The goal of this mission was to help better understand how hurricanes and other tropical storms are formed and intensify. The ECMWF three-hour forecast/analysis data are in a gridded binary (GRIB) format and tarred into daily files.

Citation

Hood, Robbie. 2020. TCSP European Centre for Medium-Range Weather Forecasts (ECMWF) [indicate subset used]. Dataset available online from the NASA Global Hydrology Resource Center DAAC, Huntsville, Alabama, U.S.A. doi: http://dx.doi.org/10.5067/TCSP/MULTIPLE/DATA101

Keywords:

NASA, GHRC, NOAA, TCSP, Costa Rica, Numerical Weather Prediction, ECMWF, WMO, GRIB

Campaign

The Tropical Cloud Systems and Processes (TCSP) mission was a research campaign sponsored by the Science Mission Directorate of NASA. The field phase of the campaign was conducted from July 1 through July 27, 2005, during the active Atlantic and eastern Pacific hurricane seasons; flying missions out of Juan Santamaria Airport in San Jose, Costa Rica.

There were 12 NASA ER-2 flights during the campaign along with 18 coordinated P-3 flights by the NOAA Hurricane Research Division aimed at studying the evolution of tropical weather systems. These airborne missions collected various types of data to be used for research related to the dynamic and thermodynamic properties of tropical disturbances, as well as their development and intensification processes. During the campaign, observations were collected for Hurricanes Dennis and Emily, Tropical Storm Gert, and an eastern Pacific mesoscale complex that may have later developed into Tropical Storm Eugene (Figure 1). The airborne and surface observations collected during the campaign provided a deeper understanding of the structure and lifecycle of tropical weather systems and helped to improve the numerical modeling of these systems. More information about the campaign is available on the TCSP Field Campaign webpage and in Halverson et al. (2007).

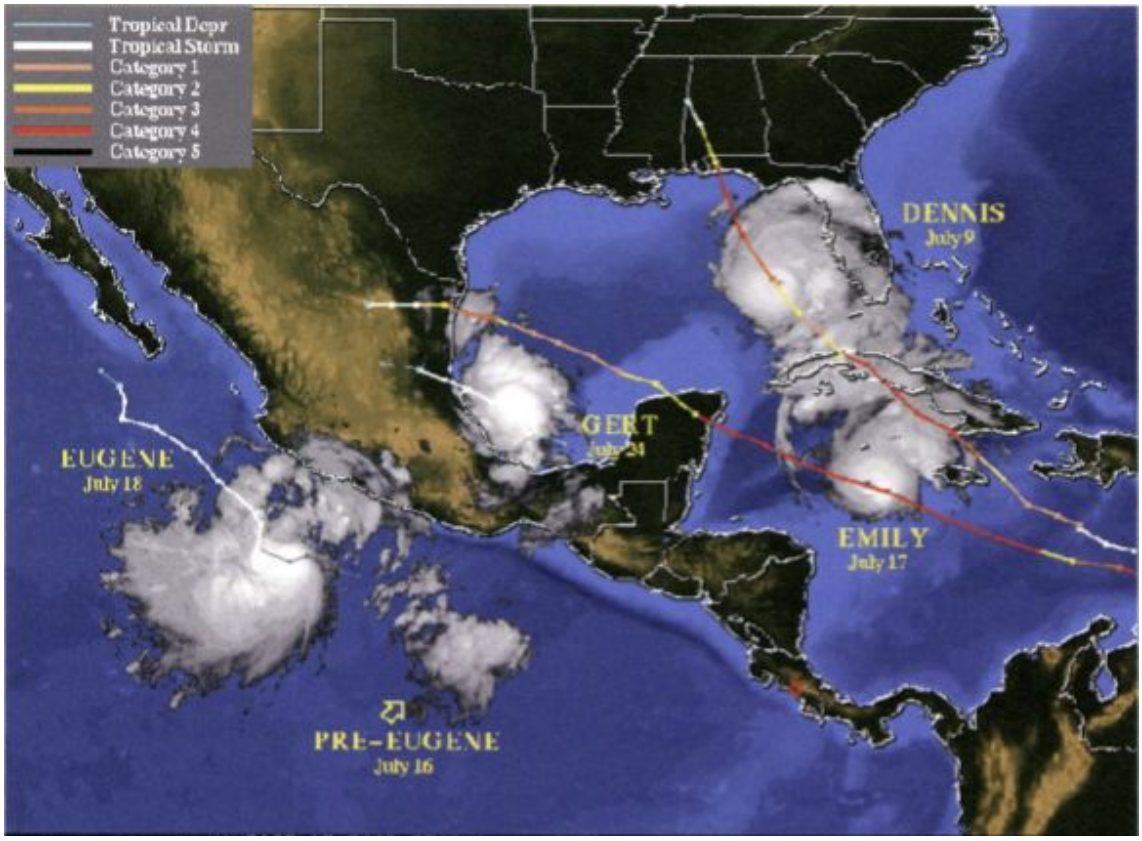

Figure 1: Storms observed by the NASA ER-2 and NOAA P-3 during TCSP, including storm tracks and intensities
(Image source: Halverson et al., 2007)

Model Description

The European Centre for Medium-Range Weather Forecasts (ECMWF), established in 1975, is an independent intergovernmental organization supported by most of the nations in Europe. ECMWF is both a research institute and a 24/7 operational service, producing and disseminating numerical weather predictions to its member states.

The ECMWF forecasting system is one of the two most well-known global weather models, along with the U.S. National Weather Service's Global Forecast System (GFS) model. The ECMWF forecasting system consists of three components: a general circulation model (coupled with an ocean wave model), a data assimilation system, and an ensemble forecast system.

Additional information about ECMWF can be found at ECMWF | Advancing global NWP through international collaboration.

Investigators

Robbie Hood
NOAA Unmanned Aircraft Systems Program
Silver Spring, MD

Data Characteristics

The TCSP European Centre for Medium-Range Weather Forecasts (ECMWF) data are available at a Level 1A processing level. More information about the NASA data processing levels are available on the EOSDIS Data Processing Levels webpage. The characteristics of this dataset are listed in Table 1 below.

Table 1: Data Characteristics

Characteristic	Description
Platform	European Centre for Medium-Range Weather Forecasts (ECMWF)
Spatial Coverage	N: 90.0 , S: -90.0 , E: 180.0 , W: -180.0 (Global)
Spatial Resolution	0.5 by 0.5 degree, gridded
Temporal Coverage	June 29, 2005 - July 29, 2005
Temporal Resolution	Three-hour data tarred into daily files
Sampling Frequency	3 hours
Parameter	Temperature, pressure, wind, humidity, water content, cloud cover, ozone mixing ratio, sea-ice cover, land-sea mask
Version	1
Processing Level	1A

File Naming Convention

The TCSP European Centre for Medium-Range Weather Forecasts (ECMWF) dataset consists of daily tar of ECMWF forecast/analysis data in GRIB format. They are named using the following convention:

Tarred Data files: tcspecmwf_2005_ddd_daily.tar

Untarred Data files: ECMWF.2005.MM.DD.ThhZ.uad_HGrbF##.A<id>

Table 2: File naming convention variables

Variable	Description
ddd	Three-digit day of the year (Julian day)
MM	Two-digit month
DD	Two-digit day
hh	Two-digit hour in UTC (time of product, i.e., 00, 03, 06, 09, 12, 15, 18, 21)
##	Type of forecast
<id>	A random number with 11 digits
.tar	TAR archive file

Data Format and Parameters

The ECMWF three-hour forecast/analysis data are in GRIB format. This format is the World Meteorological Organization (WMO) standard for exchanging gridded binary data. GRIB is used by the operational meteorological centers for storage and the exchange of gridded fields. A major advantage of GRIB is that it is self-describing. Each record has information, such as the resolution of the grid, time, variable, level, and who created the field. Additional information on the GRIB format can be found at NCEP Office Note 388 - GRIB1, NCEP GRIB1 Codes and Documents, and GRIB2 Use at NCEP. Table 3 lists data fields in the ECMWF GRIB data files.

Table 3: Data Fields in ECMWF GRIB data files.

Field Name	Unit
U velocity	m/s
V velocity	m/s
Specific humidity	kg/kg
Ozone mass mixing ratio	kg/kg
Cloud liquid water content	kg/kg
Cloud ice water content	kg/kg
Fraction of cloud cover	0 - 1
Temperature	K
Geopotential	m^2/s^2
10 metre U wind component	m/s
10 metre V wind component	m/s
2 metre temperature	K
2 metre depoint temperature	K
Land-sea mask	0 - 1
Low cloud cover	0 - 1
Medium cloud cover	0 - 1
High cloud cover	0 - 1

Total column ozone	kg/m^2
Skin temperature	K
Temperature of snow layer	K
Sea-ice cover	0 - 1
Sea surface temperature	K
Surface pressure temperature	K
Surface pressure	Pa
Total column water vapor	kg/m^2
Mean sea level pressure	Pa
Total cloud cover	0 - 1

Algorithm

Numerical weather models utilize governing equations that describe the physical behavior of the atmosphere, numerical methods that allow computers to solve these equations, and parameterizations that are used to account for processes that cannot be explicitly calculated by the model. The models begin with a set of initial conditions that are used to solve mathematical equations and predict the future state of the atmosphere. Forecast models use measurements gathered from various sources including weather balloons, weather stations, satellites, and buoys. Data from current observations are combined with the previous model forecast to update the model to current conditions in a process called data assimilation. More information about how different weather forecast models work is available on the NHC Track and Intensity Model webpage.

Quality Assessment

There is uncertainty that comes with forecast model results. The atmosphere will not behave exactly as indicated by the model output. In addition, different forecast models often yield different results. Models are simply used as guidance tools when creating weather forecasts. The NHC offers details on the verification process for model results. More information about this process is available at the NHC Forecast Verification webpage. This site lists model error trends, annual forecast error trends, and other related information.

Software

There are a number of free GRIB decoders available. One of the simplest to use is wgrib. Once you've installed wgrib, decoding grib files takes a single command line. The output from wgrib can then be read by fortran, C, or even BASIC programs. The wgrib code and documentation can be downloaded here.

For Python users, a Python module named 'pygrib' can be used to read and write GRIB files.

Known Issues or Missing Data

There are no known issues with these data or any known gaps in the dataset.

References

Halverson, J., Black, M., Braun, S., Cecil, D., Goodman, M., Heymsfield, A., ... Kakar, R. (2007). Nasa's Tropical Cloud Systems and Processes Experiment: Investigating Tropical Cyclogenesis and Hurricane Intensity Change. *Bulletin of the American Meteorological Society*, *88* , 867–882. https://doi.org/10.1175/BAMS-88-6-867

Related Data

All data collected during the TCSP field campaign are considered related. These data can be located using the GHRC HyDRO2.0 search tool and searching the term 'TCSP'.

Contact Information

To order these data or for further information, please contact:

NASA Global Hydrology Resource Center DAAC
User Services
320 Sparkman Drive
Huntsville, AL 35805
Phone: 256-961-7932
E-mail: support-ghrc@earthdata.nasa.gov
Web: https://ghrc.nsstc.nasa.gov/

Created: 02/10/20